CHAPTER 3.—LONGWALL DUST CONTROL

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In This Chapter

- ✓ Which dust source to address first
- ✓ How much air and water are needed
- ✓ Keeping dust out of the walkway
- ✓ Moving workers upwind
- ✓ Dealing with the stageloader-crusher
- ✓ Gob and wing curtains to aid airflow
- ✓ The shearer-clearer system
- ✓ Modified support movement practices

and

- ✓ Dust control for future longwalls

Controlling longwall dust is not easy. Longwall production levels are high, and there are several different sources of dust to contend with. If dust levels are high, the initial effort should be devoted to finding which source is the cause. Then, efforts to reduce dust can be concentrated where they will have the most impact.

To control dust at longwalls, a large amount of ventilation air and spray water must be used. The water must be sprayed correctly so as not to blow dust into the walkway. Techniques to change local airflow patterns can be helpful. The shearer-clearer, as well as gob and wing curtains, are examples of such techniques.

DECIDING WHICH DUST SOURCE TO ADDRESS FIRST

If a longwall is out of compliance with dust standards, knowing where the extra dust is coming from helps to get back in compliance quickly.

The four major sources of dust at longwall faces are (1) the shearer, (2) the shields, (3) the stageloader-crusher, and (4) the intake. Finding the source of the extra dust involves two tasks. First, the dust from each source must be measured. Second, these measurements must be

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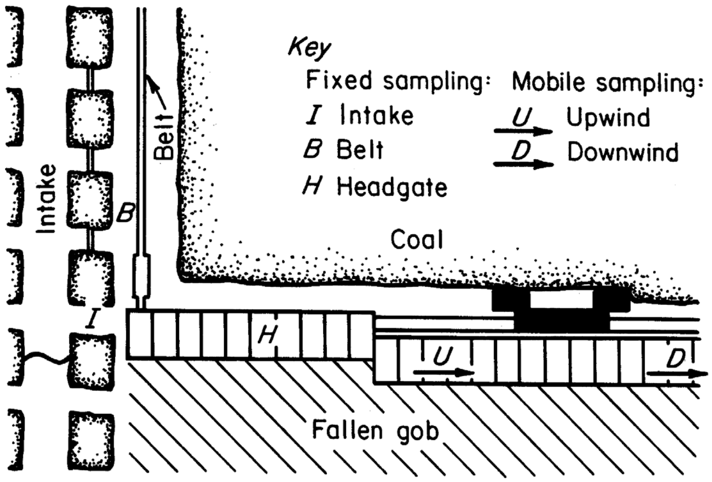

Figure 3-1.—Longwall dust sampling locations.

compared to previous samples or to results from other longwalls in order to discover which dust source is causing the problem.

Finding the amount of dust from each source. The first task is to take dust samples to measure the amount of dust from each source. Initially, fixed-site on-section[4] dust samples should be taken at locations I and H shown in figure 3-1. Location I gives the intake dust level. Location H is at shield 10 and includes the intake dust in addition to the stageloader-crusher dust. The stageloader-crusher dust is obtained by subtracting the dust level at I from the dust level at H. To ensure reasonable accuracy, a package of at least two samplers should be used for three shifts.

If belt air is used to ventilate the longwall face, the belt air dust concentration at location B should be measured. If the airflow at both B and I is measured, a corrected average concentration from the two locations can be calculated.[5] The concentration at H then reflects[6] the addition of the stageloader-crusher dust[7] to the intake and belt dust.

Separating out shearer dust is a harder task. It requires two people who follow the shearer as it cuts. Each person carries several dust samplers. One stays upwind of the shearer (location U in figure 3-1); the other stays downwind of the shearer (location D in figure 3-1). The shearer dust contribution is the difference between the upwind and the downwind dust concentration values,[8] locations U and D.

Shield dust is measured in the same way, using upwind and downwind measurements, except that the sampling pumps are turned on only during the head-to-tail pass to minimize background dust levels. One person stays 25 ft upwind of shield movement; the other stays 25 ft downwind[9]

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[4]On-section means that sampling is done while the shearer is operating, not portal to portal.

[5]If the concentration and airflow at I are C_I and Q_I and at B are C_B and Q_B, then the corrected average concentration is $[(C_I Q_I) + (C_B Q_B)] / [Q_I + Q_B]$.

[6]The reason that concentration (mg/m^3) is used instead of dust make (mg/sec) is that the dust make value is subject to error caused by air loss into the gob, which takes place between locations I and H.

[7]The concentration measured at H will contain a small amount of shearer dust from the cutout at the headgate. This error can be eliminated by turning off the sampling pump when the shearer is upwind of shield 10.

[8]This assumes that shield movement is far enough from the shearer to be subtracted out.

[9]The 25-ft value is approximate and may vary slightly depending on circumstances. If the downwind person gets too close to the shearer, the samplers will be biased upwards by shearer dust. If the downwind person gets too close to the moving shields, the samplers will be biased upwards because the shield dust, which falls mostly into the walkway, has not fully mixed into that portion of the airflow moving through the shield legs and down the panline. See figure 3-5 and the accompanying explanation.

of shield movement. This "mobile sampling" has been described more fully by Colinet et al. [1997] and Srikanth et al. [1995].

Source comparison with other longwalls. Once sampling is completed, the results should be compared to earlier results obtained at the same mine or to other longwalls. Colinet et al. [1997] give dust source contributions obtained from a survey of 13 longwalls (table 3-1). The average percent values reflect the average contribution of a given source. For example, on average, intake sources account for 9% of the dust at the longwalls that were surveyed.

The concentration values in table 3-1 reflect dust levels measured *only when the shearer was operating*, using the sampling locations shown in figure 3-1 and explained in the accompanying text. Except for the intake, the values shown represent the difference between the upwind and downwind dust concentration values. They are *not* personal exposure values.

Any dust source showing a contribution greater than the median value of table 3-1 is a likely source of the extra dust that has caused the longwall to go out of compliance.

Table 3-1.—Dust source contribution values from 13 longwalls [Colinet et al. 1997]

SOURCE	AVERAGE PERCENT	CONTRIBUTION MEDIAN	CONTRIBUTION RANGE
Intake	9	0.33 mg/m^3	0.07-1.1 mg/m^3
Stageloader-crusher	15	0.78 mg/m^3	0.29-1.3 mg/m^3
Shields	23	1.8 mg/m^3	0.67-2.3 mg/m^3
Shearer	53	3.5 mg/m^3	0.7-8.8 mg/m^3

BASIC LONGWALL DUST CONTROL TECHNIQUES

Basic techniques are those widely used to control dust, applicable at every longwall. Mine operators can use high water and airflows and take measures to avoid blowing dust into the walkway. They can also move workers upwind, reduce dust from the stageloader-crusher, use a gob curtain, and use a shearer-clearer system.

Raising airflow to control dust. Raising the airflow provides some benefit when the existing face air velocity is below 600 ft/min [Organiscak and Colinet 1999]. Over the years, longwall air quantities have risen to compensate for higher production levels [Haney et al. 1993; Ondrey et al. 1994]. A survey by the Mine Safety and Health Administration in 1999 showed that longwalls had an average intake air quantity of 71,000 cfm[10] and an average headgate-end face velocity of 650 ft/min. Eighteen percent of longwalls exceeded 100,000 cfm in the intake

[10]For mines in coal under 8 ft, the average was 66,000 cfm; for mines 8 ft or more, 87,000 cfm.

airways. This high air quantity helps to control respirable dust by providing better dilution of dust sources.[11]

For many years, there has been a concern that high air velocities would entrain settled dust. However, 10% of longwalls now have face air velocities exceeding 1,000 ft/min without experiencing any evident[12] entrainment problems. This lack of dust entrainment is probably due to high water application rates in conjunction with shield washing.

Using water to control dust. Dust generated by the shearer is reduced by increasing the quantity of water *supplied to the shearer drums*, so it is important to supply as much water as possible to the drums. In two separate studies, water flow to the shearer drums was increased about 50% and dust levels at the shearer were reduced about 40% [Shirey et al. 1985]. In a survey of 13 longwalls, Colinet et al. [1997] report an average shearer water flow of 100 gpm, almost all of it to the drums.

The number of sprays and the type of spray nozzle chosen are important for best dust control performance. For example, pick-point sprays at the outer edge of the vanes, now commonly used, are superior to the old cavity-filling sprays that were mounted on a pipe welded to the side of the vane [Jankowski et al. 1987]. Also, the greater the number of sprays, the more thoroughly water is mixed with the broken coal. In a test that varied the number of sprays, Bazzanella et al. [1986] showed that dust suppression is improved by increasing the number of sprays on a shearer drum, even when the total water flow and nozzle pressure were held constant with the use of smaller orifice nozzles. When 46 smaller orifice nozzles were substituted for the 17 original nozzles, dust was reduced by 60%. This finding shows that there should be at least one spray for each pick on the drum.

Design of the water supply system is an important consideration if sprays are to be effective. Each water split should have its own flow meter and pressure gauge for convenient monitoring. All of the system components must be sized for the anticipated water flows, with particular attention devoted to the size of the pipe that goes through the ranging arm and connects to the feed lines in the drum spiral. Water filtration is often a source of headaches. The coarsest filter mesh size that can normally be used is 50 micron, and the stream of water should not bypass the filter mesh when it plugs up.

Avoiding the migration of dust into the walkway. Since water sprays are known to entrain air and generate their own local air currents, they must be used in a way that allows dust from the drums to hug the face and not be blown out into the walkway. Figure 1-4 illustrates how sprays on the body of a longwall shearer can actually *raise* the shearer operator=s dust level by blowing

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[11]While increases in airflow are applicable at every longwall, it does not follow that such increases are always feasible. Depending on the age of the mine and the design of the ventilation system, major ventilation increases are not always practical. Such mines will have to depend more on the other dust controls.

[12]Evident from underground measurements, at least. Recently, Listak et al. [2001] conducted lab studies to assess the impact of higher face velocities on shield dust. Dry (1% moisture) mixed-size particulate was dropped into an airstream flowing in a horizontal wind tunnel. Surprisingly, airflow increases resulted in much higher dust concentration levels.

dusty air into the walkway. Because of this air-entrainment effect, it is generally better not to have sprays mounted on the shearer body, unless they are part of a "shearer-clearer" configuration as described below.

Despite the need to keep sprays off of the shearer body, the motor cooling water must be discharged somewhere. The recommended location for these sprays is low on the end of the shearer, pointed straight down onto the panline so that they wet the coal on the panline and cause little air entrainment [Jankowski and Hake 1989].[13]

Excessive pressure on the drum sprays also blows dust into the walkway. In two separate studies [Pimentel et al. 1984; Kok and Adam 1986], the water pressure of the drum sprays was increased from 75 to 115 psi and 80 to 150 psi, respectively. In both instances, dust exposure of the shearer operators increased by 25% because the higher pressures on the trailing drum blew the dust into the walkway. Thus, the best drum spray pressure is in the range of 80 to 100 psi. Because of the tendency of high-pressure sprays to blow dust into the walkway, the water flow rate should always be raised by increasing the nozzle orifice size rather than the operating spray pressure.[14] However, when the nozzle pressure is below 80 psi, the sprays may plug with coal particles pushed in from the outside.

Moving workers upwind. Although measures can be taken to reduce the migration of dust into the walkway, the shearer-generated dust cloud at the face soon spreads from the panline to envelop the entire longwall face cross-section. Because of this dust cloud spreading, any mining practice or technology development that moves workers upwind of the shearer drums and moving supports is helpful. For example, use of remote control on shearers can significantly reduce dust exposure of the machine operators. A survey by the U.S. Bureau of Mines [1984] showed that exposure was reduced 68% by moving the operator just 20 ft upwind of the shearer body. Particular attention should be paid to the location of the tailgate-end shearer operator, who should always be positioned upwind of the tailgate-end drum to reduce dust exposure.

Shearer operators can further reduce their dust exposure by moving as far upwind at the headgate as possible as the shearer cuts out at the headgate.

Reducing dust from the stageloader-crusher. The stageloader-crusher can be a major dust source on longwall faces. To reduce this dust, the stageloader-crusher is enclosed with steel plates and strips of conveyor belting. All seals and skirts must be carefully maintained to ensure that dust stays inside the stageloader-crusher enclosure. Several sprays are mounted on internal spray bars, which usually span the width of the conveyor. Recommended spray bar locations are the mouth of the crusher, the discharge of the crusher, and at the stageloader-to-belt transfer point. Water pressure should be maintained below 60 psi, since high-pressure sprays may actually force dust out of gaps in the enclosure and into the intake air. During underground trials, covering the stageloader and adding spray manifolds to boost the water flow from 10 to 20 gpm yielded dust reductions of 79% at the headgate operator and 41% at support 20 [Organiscak et al.

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[13]Some mines use the cooling water to wash the shearer haulage track.

[14]The spray pressure is measured by removing one spray nozzle and attaching a hose that leads to a pressure gauge.

1986; Kelly and Ruggieri 1990b].[15] The most important spray bar is the one located on the discharge side of the crusher [Jayaraman et al. 1992].

A few operators have attached dust collectors to the stageloader enclosure. This yielded no better results than just covering the stageloader and adding internal spray manifolds [Jayaraman et al. 1992]. Still, if enclosing the stageloader and adding internal sprays are not sufficient, a dust collector attached[16] to the stageloader is the next step.

Reducing dust from the intake. While the intake is usually the least significant source of longwall dust, it cannot be ignored. Reductions in intake dust from using homotropal ventilation, cleaning the panel belt, and adding water to the intake roadway have been discussed by Organiscak et al. [1986]. Other methods to reduce roadway dust are discussed in chapter 5 on surface mining. For mines that use belt air, the reduction of conveyor belt dust is discussed in chapter 6 on hard-rock mines. Work crews in the intake will often stir up dust, and rescheduling of work may be necessary.

Using a gob curtain to aid airflow. A gob curtain is a brattice curtain installed from the roof to the floor between the first support and adjacent rib in the headgate entry. It prevents air from leaking into the gob, forcing more of the ventilation airflow to make a 90º turn and stay on the face side of the supports (figure 3-2). This permits more dilution of dust in the region of the face near the headgate. Without a gob curtain, a substantial portion of intake air will pass into the gob, moving laterally behind the supports. During underground trials, the average face air velocity with the curtain installed was 35% greater than that without the curtain [Jankowski et al. 1993]. The most significant improvement was seen for the first 25 to 30 supports.[17]

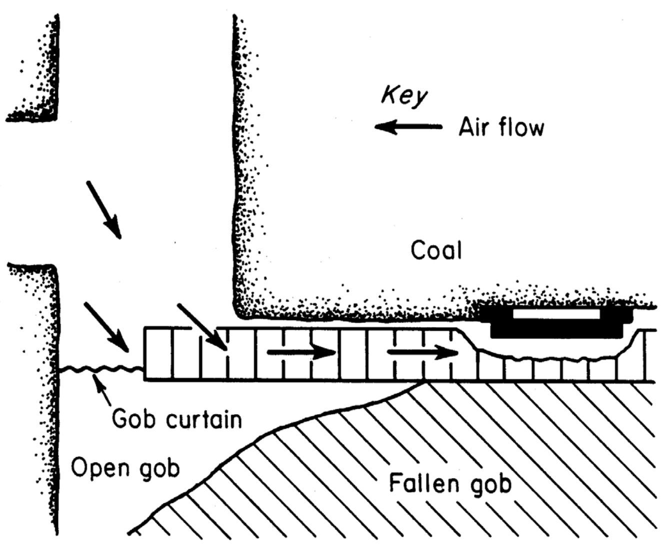

Figure 3-2.—Gob curtain forces air to stay on longwall face.

Gob curtains also have a secondary benefit. When less air enters the gob, then less air returns to the face halfway down the shield line. Therefore, dust generated by gob falls is less likely to be entrained and carried back onto the face.

Using the shearer-clearer system.

[15] These were old studies done at low (by today's standards) production levels. Much higher water flows are necessary for today's longwalls.

[16] A dust collector on the stageloader will see a very high particulate load, so horizontal ductwork should be avoided and access doors for cleanout should be provided.

[17] Some operators use curtains or conveyor belt strips to seal the gaps between the first few shields. No data are available on how well this works to keep air on the face.

A large portion of U.S. longwalls use a water spray system called a shearer-clearer, specifically designed to hold shearer-generated dust against the face. The shearer-clearer takes advantage of the air-moving capabilities of water sprays to direct the dust cloud downwind along the panline, which prevents it from spreading out into the walkway (figure 3-3). The system consists of several shearer-mounted water sprays, oriented downwind, and one or more passive barriers, which split the airflow around the shearer into separate clean and contaminated air streams (figure 3-4).

The air split in the shearer-clearer system is started by a splitter arm, with a strip of conveyor belting hanging from the splitter arm down to the panline. This belting extends from the top gobside corner of the shearer body to the cutting edge of the upwind drum. A spray manifold mounted on the splitter arm confines the dust cloud generated by the cutting drum, further enhancing the air split. The dust-laden air is drawn over the shearer body and held against the face by spray manifolds positioned between the drums on the face side of the machine. The air is then redirected around the downwind drum by a set of sprays located on the downwind end of the shearer. Operating pressure must be about 150 psi,[18] measured at the nozzle, to ensure effective air movement. Total water flow rate with all sprays operating is about 12 gpm.

In underground tests, the shearer-clearer reduced operator exposure from shearer-generated dust by at least 50% when cutting against the ventilation and 30% when cutting with the ventilation [Ruggieri et al. 1983; Jayaraman et al. 1985].[19]

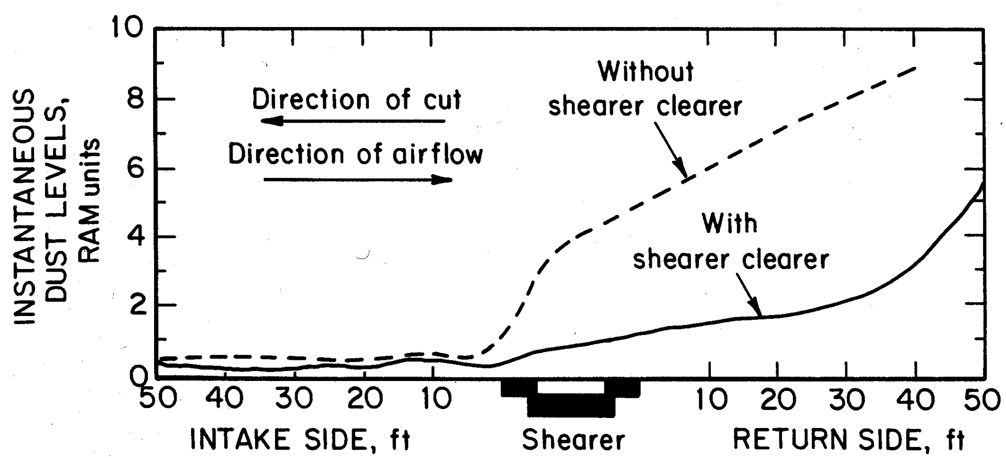

Figure 3-3.—Typical respirable dust concentration profile around the shearer during the tail-to-head pass.

[18]Proper pressure and spray placement are important if the expected reduction in dust is to be realized [Ruggieri et al. 1983].

[19]Other experiments have been done to test a shearer-clearer in conjunction with passive barriers mounted on the shearer. The passive barriers gave no improvement in dust when added to the shearer-clearer. However, the passive barriers alone (without the shearer-clearer) gave a 25% reduction in shearer dust compared to the baseline (no barriers, no shearer-clearer) [Jankowski and Babbitt 1986; Kelly and Ruggieri 1990a].

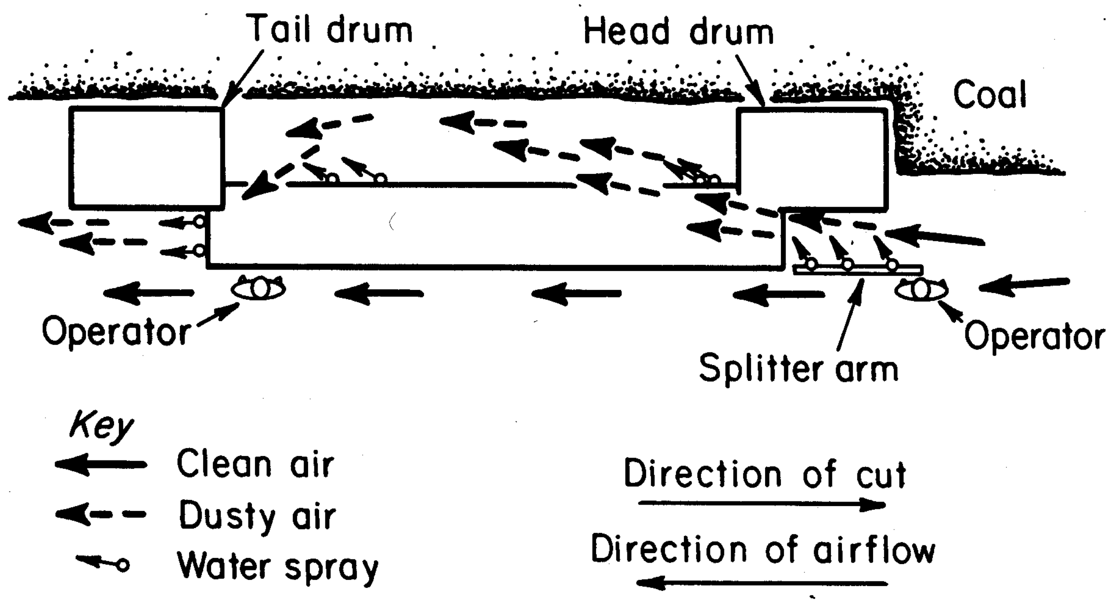

Figure 3-4.—Air currents when using the shearer-clearer system.

A helpful installation manual for the shearer-clearer is available [Ruggieri and Babbitt 1983].

Cutter drum maintenance. Routine replacement of badly worn, broken, or missing bits improves cutting efficiency and helps reduce dust. Also, bits designed with large carbide inserts and smooth transitions between the carbide and steel shank typically produce less dust [Organiscak et al. 1996a]. The water sprays should be serviced along with the bits, since the number of operating drum sprays greatly impacts the amount of dust generated [Bazzanella et al. 1986].

SITE-SPECIFIC LONGWALL DUST CONTROL TECHNIQUES

Site-specific techniques can be effective when allowed by the local geology and suitable to the type of equipment used. Mines can use unidirectional cutting, modify their support movement practices, and use a wing curtain to aid airflow.

Using unidirectional cutting. Some mines in very high coal use a unidirectional cutting sequence because it offers operational advantages. Unidirectional cutting allows somewhat greater flexibility to place workers upstream of dust sources than bidirectional cutting. If the primary cut takes place as the shearer moves in the head-to-tail direction, the leading drum that cuts most of the coal is downwind of both shearer operators and roof support movers. Dust surveys [USBM 1984] have shown that cutting in the head-to-tail direction yields dust levels about 40% less[20] than cutting in the tail-to-head direction.

On the other hand, if the primary unidirectional cut is in the tail-to-head direction, supports can be advanced just downwind of the shearer, keeping both shearer and support dust away from face workers. This cut direction works well when a shearer-clearer system is used to hold the dust against the face.

Whether unidirectional cutting can be done depends on the type of equipment used and the local roof conditions. A head-to-tail cut requires most of the coal and rock to pass under the shearer, and sufficient clearance under the shearer is required to prevent clogging. Also, a head-to-tail cut may not be necessary if shearer dust has been avoided in some other way, such as remote control. When the supports are advanced during the cycle will depend on how much the supports are adding to the overall dust problem and how long the freshly cut roof can stand without falling.

The downside of unidirectional cutting is that it may result in some loss in productivity by virtue of the reduction in cutting time. However, the cost of any expected productivity loss must be balanced against the cost of alternative dust controls.

The most common unidirectional sequence is to cut coal on the tail-to-head pass, closely following the shearer with the support advance. With this sequence, no workers are exposed to support-generated dust, and the shearer dust is held in check with a shearer-clearer system operated in conjunction with remote control.

Using modified support movement practices to reduce dust. During bidirectional cutting, support advance will occur in both cutting directions. Support movers can stay away from support dust by positioning themselves upwind of the moving supports.

During the head-to-tail cut, shearer operators are exposed to any dust generated by support movement. Support dust tends to be generated directly over the walkway, so under the moving support the concentration in the walkway will be higher than in the adjacent support legs or panline. As this support dust moves downwind, the walkway concentration declines as the walkway dust cloud mixes with the air moving down the panline and the air moving through the support legs. As a result, some mine operators find that support-generated dust can be diluted more before it reaches the shearer operators by increasing the distance between support advance and the shearer from 20 to 50 ft (figure 3-5).

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[20]The 40% figure refers only to shearer-generated dust measured at the shearer. Use of shearer remote control could increase or decrease this value.

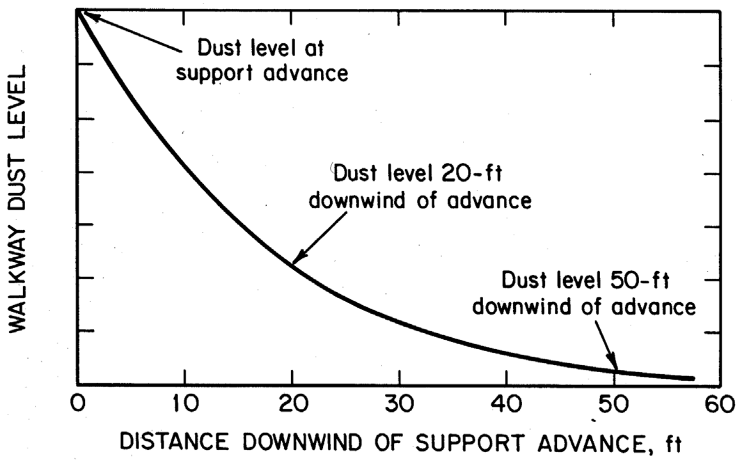

Figure 3-5.—Support dust in the walkway dilutes as it moves downwind [Organiscak et al. 1985].

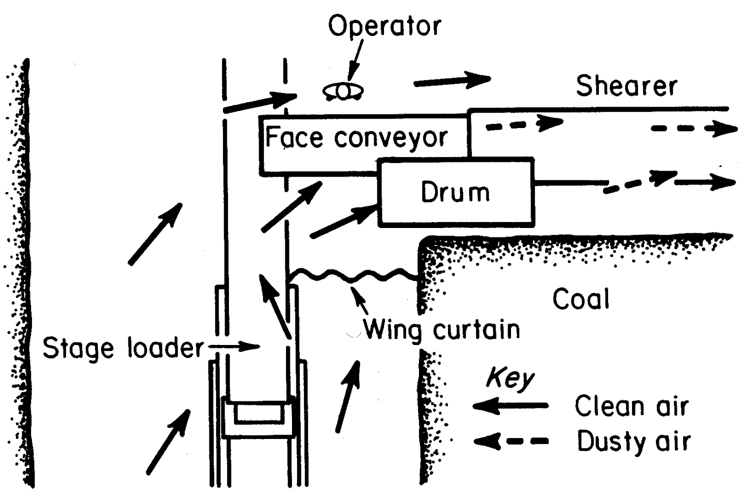

Figure 3-6.—Airflow at longwall headgate with a wing curtain.

During the tail-to-head cut, with shield advance following downwind, shields should be pulled as closely behind the shearer as possible. This keeps the shield movers ahead of the shearer dust cloud, which progressively spreads into the walkway as it moves downwind from the shearer. In this case, a shearer-clearer system may be of considerable help to the shield movers, since it holds the dust cloud over the panline for a greater distance downwind of the shearer, as shown in figure 3-3.

Water application on the immediate roof also may help to suppress some of the support dust generated during lowering, advancing, and resetting of the roof supports. The immediate roof can be wetted by spraying the roof with one or more narrow-angle water sprays mounted on top of the shearer body, directing water downwind at an upward 45° angle.

In addition, shield supports can be equipped with water sprays in the shield canopy that wet the broken roof debris on top of the shields. These achieve modest 25% reductions in shield-generated dust [Henke and Thiemann 1991], but are hard to maintain, especially since they soak the face workers. Mangolds et al. [1990] have reviewed the (mostly unsuccessful) attempts to control shield-generated dust.

Using a wing curtain to aid airflow. The purpose of a wing curtain is to shield the shearer operators from the very high concentrations of dust generated as the headgate drum cuts into the headgate entry. The high-velocity primary airstream passing over and through the drum entrains and carries large quantities of dust out into the walkway and over both operators. When a wing curtain is installed between the panel-side rib and the stageloader (figure 3-6), it shields the headgate drum from the airstream as the drum cuts out into the headgate entry.

The wing curtain is located 4 to 6 ft back from the corner of the face to provide maximum shielding without interfering with the drum. The curtain is only in place during the cutout operation and is generally advanced every other pass. A wing curtain can reduce operator dust exposure by 50% to 60% during the headgate cutout [Jankowski et al. 1993; Cecala et al. 1987].

FUTURE POSSIBILITIES FOR LONGWALL DUST CONTROL

Because of longwall production increases over the years, there is a continuing demand for better dust control. This section discusses dust control methods that might be used at future longwalls. Some are newer methods. Others are older methods that have been little used because of higher cost or operating difficulties. Examples of future possibilities are advances in production technology, water infusion, foam, a face partition, and high-pressure drum sprays.

Advances in production technology. Any advance in longwall production technology that allows workers to move upwind of dust sources will reduce their dust exposure. This has already taken place through the use of remote control of shearers and batch control of shields.

The implementation of more advanced technology has been delayed because of practical operating difficulties with these systems. For example, control packages are now available for complete automation of shield movement; however, they are not yet in wide use.

Another advanced technology that offers lower longwall dust levels is the memory-cut system in which a computer logs the precise height of the drums as the shearer moves across the face. With such a system, the operators make the initial cut, and the computer controls several subsequent cuts while the operators wait in a less dusty location. Several memory-cut systems have been sold to mine operators. Again, they are not yet in regular use because of practical operating difficulties.

Nothing works as well as measures that put workers upwind of dust sources. Because of this, any new technology that moves workers upwind can greatly reduce their dust exposure [Organiscak et al. 1996b].

High-Pressure Inward-Facing Drum Sprays. High-pressure water can have a significant impact on shearer-generated dust. The basic concept is to use high-pressure drum sprays to improve wetting of the coal and improve the airborne capture efficiency of the sprays. The nozzles are angled inward to avoid blowing the uncaptured dust cloud out into the walkway.

An underground evaluation of high-pressure, inward-facing drum sprays gave good results [Jankowski et al. 1989]. Of those tested, the most effective spray system was the 30°, 800-psi configuration. Not only was the dust reduction greater (39%), the concentration was lower at all sampling sites using this configuration. Also, wetting of the coal was improved since intake dust levels along the face were reduced by about 45%.

A drawback of high-pressure sprays is that the small-orifice nozzles tend to clog unless the water is very clean. Also, space has to be found on the shearer for a booster pump or the pump located outby with a high-pressure line running to the shearer. Neither alternative may be feasible.

Solid-stream (jet) sprays. Some preliminary longwall tests during the 1980s [Kost et al. 1985; Jankowski et al. 1987] showed that using solid-stream (jet) sprays on the shearer drum yielded 30% less dust at the shearer operator position than the conventional conical sprays. Whether this dust reduction was due to better wetting of the coal or less boil-out from the drum is not clear. Followup tests to confirm these results under a variety of conditions were never done.

Foam. Tests in two mines have shown that foam works well to lower dust when it is released from nozzles located on the shearer drums. In the first mine, the shearer operator dust exposure was cut by 56% compared to conventional water sprays on the drum. In the second mine, operator dust exposure was cut by 84%, and the dust level at the tailgate declined by 78% compared to water sprays [Laurito and Singh 1987; USBM 1989]. Also, during the test the foam system used less water than the conventional sprays.

A test in a third mine measured the impact of foam applied with nozzles located on the ends of the shearer body. The effectiveness of this external foam application was less than 20%, indicating that for foam to be effective, it must be applied through the shearer drums so as to be thoroughly mixed with the coal.

Long-term tests to assess feasibility and cost of foam at longwalls have not been done.

Face partition. The concept of a face partition is to maintain two parallel splits of air along the longwall face by a transparent mesh partition (figure 3-7). This partition acts to retard the spread of shearer-generated dust into the walkway, reducing the dust exposure of the shearer operators and roof support movers [Organiscak and Leon 1993; Organiscak 1999]. During testing, a 1/8th-inch mesh partition was hung from the roof supports to separate the walkway from the panline. When the partition stayed parallel to the face, walkway dust was cut in half. However, where supports were being advanced, there was always a short segment of mesh partition perpendicular to the airflow. This perpendicular segment caused a decline in partition effectiveness. Overall, the results were mixed.

Water Infusion. To infuse a coal seam, boreholes are drilled into the coal seam ahead of mining and large volumes of water are pumped in under high pressure to wet the coal [McClelland et al. 1987; Lama and Liu 1992; Stricklin 1987]. Water infusion has been used occasionally by mine operators for several decades. Although it is not widely used because of high cost, water infusion

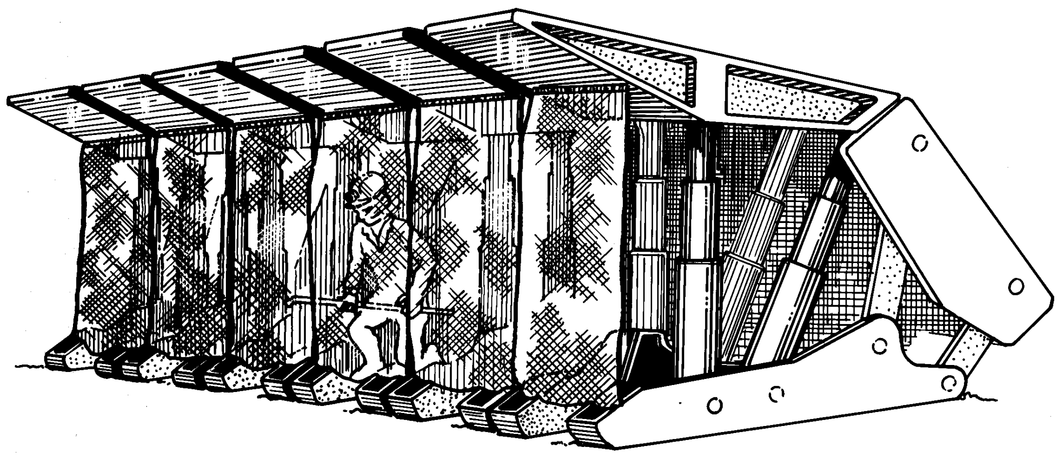

Figure 3-7.—Transparent mesh partition retards the spread of shearer dust into the walkway.

of coal seams will reduce dust by about 50% in those seams that can be infused.[21] Many coal seams cannot be infused. Water infusion is much more economical if the holes have already been drilled to remove methane gas.

Homotropal ventilation. With homotropal ventilation, intake air is routed up the tailgate entries and across the longwall face from tailgate to headgate, where it then passes into the gob. A separate split of air must be routed up the headgate entry to keep the headgate operator out of dusty return air [Stevenson 1985].

Because air routed up the tailgate entries is free from the headgate-side dust sources, the dust exposure of workers on the face is lower. The disadvantages of homotropal ventilation are that the tailgate-side entries must be kept in good condition and the gob at the headgate must remain open. Otherwise, the flow of air will be restricted. Keeping the tailgate entries and the headgate side of the gob open may require additional cribbing [Kelly and Jankowski 1984]. Homotropal ventilation may only be feasible in a small proportion of mines.

Water proportioning. While it is well-known that more water added to the shearer drums will reduce dust, the maximum amount of water that can be added is usually limited by operational problems (such as softer clay floors and slipping conveyor belts) that are created by excessive water. Since the upwind drum is usually the one that contributes the most to worker dust exposure, some success in reducing dust might be obtained by proportioning more water to the upwind drum. However, solid evidence for an overall benefit is lacking [Kok and Adam 1986].

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[21]Many coal seams cannot be infused because of nonuniform seam permeability.

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